Special issue

Status and distribution of Paraguayan canids

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Keywords: Canidae, Cerdocyon thous, Chrysocyon brachyurus, Lycalopex gymnocercus, Paraguay, Speothos venaticus

Abstract

Four species of canids have long been documented in Paraguay, but we have learnt little about their ecology in the country since the works of Azara and Rengger in the early 19th Century. This paper collates specimen and literature data about this group to act as a basis for the stimulation of future research, reviewing canid specimens in all the major Paraguayan collections and all significant specimens in international collections. Data are presented in a hierarchical manner, with examined specimens, non-examined specimens, literature records, photographic records, reliable sight records distinguished, and a distribution map provided for each species. The vast majority of canid specimens were collected at least 35 years ago and the majority are from the Chaco region, with the Oriental region (east of the Paraguay River) extremely poorly sampled. Data suggests that two species (Cerdocyon thous and Chrysocyon brachyurus) are widespread in both regions of the country, and one species (Speothos venaticus) has an extremely restricted distribution. The remaining species (Lycalopex gymnocercus) has long been claimed to be widespread in both regions of the country, but although the species is widespread throughout the Chaco region, I was unable to find any documented evidence of the species in the Oriental region of Paraguay beyond a single photographic record from Isla Yacyretá in the Paraná River. I suggest that further investigation is required to confirm the true extent of this species’ distribution in Paraguay.

Introduction

The Paraguayan Canidae includes four species in four genera (de la Sancha et al. 2017, Saldivar et al. 2017). However, studies on the group in Paraguay have been virtually non-existent, and basic data on the ecology and distribution of the species in the country is lacking, confused, or inadequate (Smith and Ríos in press). With a view towards consolidating the available data on the distribution and status of Paraguyan Canidae, a review of the specimens, literature, and reliable field records was performed. The results are presented here.

The history of canid studies in Paraguay

The fauna of the Jesuit territory of “Paraquaria” (which encompassed a large area of northern Argentina, Paraguay, southern Brazil, and eastern Bolivia) were described by several early Jesuit missionaries, notably Dobrizhoffer (1784) who mentioned three species of “foxes”, the large one called Kaalk by the Abipones, the middle-sized one called Licheran, and the smallest Licher. The author only provided a description of the third, revealing it to be a skunk (Mephitidae) and the identity of the other two can only be guessed. Writing around the same time, Sánchez Labrador (1910) also described a skunk (Nigotego) as a species of fox; as well as another fox-like animal which he called Cachoque that is “grey mixed with white” and a “nocturnal enemy of birds”; and a larger, longer-haired species that is the size of a deer and “howls at night with sounds that closely resemble human screams”. The identity of the latter two species is moot, but Cerdocyon thous and Chrysocyon brachyurus are probable candidates.

The first systematic treatise dealing with the Paraguayan species was de Azara (1801, 1802) who described two species of “foxes”, I’Agouara-Gouazou and l’Agourachay, providing detailed descriptions of the behaviour of each species. This was later translated to English by Hunter (1838). Rengger (1830) employed the same common names as Azara and correctly attributed them to the species now known as Chrysocyon brachyurus and Cerdocyon thous respectively, providing considerable new ecological data on both species. For much of the 19th Century this arrangement went unquestioned as l’Agourachay was repeatedly associated with C. thous but, during the early 20th Century, authors abruptly began to associate it instead with Lycalopex gymnocercus (Thomas 1914, Osgood 1915). The description was eventually demonstrated to be a composite of both species by Smith and Ríos (in press), who also provided an extensive discussion on the nomenclatural confusion resulting from the sudden change in usage.

The first published mention of L. gymnocercus in Paraguay that applied unequivocally to that species is thus much later than usually assumed, and in reference to specimens collected in the Chaco region by Wetzel and Lovett (1974). An earlier, unpublished specimen (FMNH 63861) had however been collected in Paraguay by the Mennonite collector Jakob Unger at Orloff, Boquerón department on 25 February 1946. Two specimens (AMNH 95205 and 95204) collected by Francisco Schade on 20 and 24 August 1931 predate the Unger specimens, but the locality “Villarrica, Guairá, Paraguay”
is suspect. Schade resided in Villarrica, but many of the specimens he collected that bear that locality were obviously collected elsewhere, and Villarrica lies outside of the currently known range of the species. I have been unable to examine these specimens to confirm that they are correctly identified, and consequently I consider that they are best discounted until the expressed doubts can be dispelled. The fourth species, *Speothos venaticus*, was reported for the first time by Bertoni (1924). Oddly, Bertoni (1939) later included *S. venaticus* in the family Mustelidae.

Nomenclatural confusion in the family at the turn of the 20th Century (Allen 1905, von Ihering 1910, Thomas 1914, Osgood 1915, 1934, Stiles and Baker 1930, Cabrera 1931) is reflected in the constantly changing nomenclature and confusing taxonomy employed by Bertoni (1914, 1924, 1925, 1939). This was probably at the root of much of the misunderstanding of the Paraguayan distribution of *L. gymnocercus* which has long persisted in the literature (Lucherini and Vidal 2008) and has only recently been resolved (Smith and Rios in press). However, beyond this point, with few exceptions (Brooks 1992), investigation into Canidae in Paraguay has been virtually nil and it was not until more recent times that *S. venaticus*, traditionally one of the least known canids, became the subject of study at Reserva Natural Bosque Marcaracay (Becaceci 1994, Zuercher et al. 2001, 2003, 2004, 2005, Zuercher and Villalba 2002. DeMatteo et al. 2004) and a captive breeding programme was coordinated by Raúl Binacional (von Humbeck and Perez 1998). Ironically, this perhaps ignominiously qualifies it as the most well-studied canid species in Paraguay.

In modern usage, the name Aguara is commonly employed to refer to “foxes”. However, the word is not used exclusively for canids, and is also used in reference to the crab-eating raccoon (*Procyon cancrivorus*, Aguara pepe) or more rarely for Molina's hog-nosed skunk (*Conopatus chinga*, Aguara ne). Cartes (2014) argues that the word Aguara is composed of two parts Agua meaning “rounded or bulky” and Ra/Rague meaning “fur or pelage”, interpreting the word as literally translating to “fierce animals with long fur or bulky tail”. On the other hand, Jagua (meaning in modern usage “dog”) was initially used to refer to fierce animals with short fur (Cartes 2014).

The conservation status of Paraguayan Canidae was recently reviewed, with two species found to be worthy of conservation concern (*C. brachyurus* and *S. venaticus*: Saldívar et al. 2017, Giordano et al. 2017). All species are listed on CITES Appendix II, except *S. venaticus* which is on Appendix I (Morales 2007).

**Methods**

Specimens of Canidae from the major zoological collections in Paraguay were examined during 2017 – 2019, identifications were confirmed by inspection of the specimens, and locality data was collated from museum databases and specimen labels. The location of specimens in foreign museums was gleaned from the literature and from Vert Net (which returned 260 results for Paraguay Canidae). Where possible, specimens considered to represent significant geographical range extensions were reviewed with the assistance of museum curators. Those that did not present noteworthy distributions were assumed to be correct and not examined. Collection codes for museums housing Paraguayan canid specimens are listed in Appendix 1.

Species accounts begin with the current common name (following Hunter and Barrett 2011), scientific name, and author presented in bold type. The original described name, author, and type locality follow. There then follows a referenced list of the synonyms used in the Paraguayan literature with a single word descriptor of the subject of the publication in square brackets: aberration, abundance, biogeography, checklist, conservation, distribution, ecology, etymology, first record, folklore, husbandry, guide, list, mention, mortality, nomenclature, parasitology, specimen/s, taxonomy, tracks, use. The synonymy deals only with Paraguayan literature or literature citing Paraguayan specimens and is not intended to be a complete list of synonymy for the species. Subsection *Local names* lists all local common names published in the Paraguayan literature. An attempt to reference the earliest published usage for each name is made. Subsection *Comments* addresses noteworthy or confusing themes in the Paraguayan literature. There then follows a “hierarchical reliability” approach to the Paraguayan distribution of each species under *Geographical distribution*. This approach is taken so as not unduly bias understanding by depending solely on the limited specimen record. The hierarchies are, in order of documented reliability: 1) Examined specimens, 2) Specimens not examined, 3) published literature record (*Literature references*), 4) published photographic record (*Photographic records*), 5) reliable field observation by one of the authors or a knowledgeable local observer (*Reliable observations*). Records are presented with the political department in italicised capitals, followed by the details of the record (in alphabetical order). For specimen records this involves the species number (museum codes in Appendix 1) followed by the locality. These records are also mapped distinguishing the hierarchical categories so that readers may interpret their reliability for themselves (Figures 3–6). Records corresponding to categories 4) *Photographic records* or 5) *Reliable observations* include only localities that are not covered by any one of the previous three categories.
The criterion for inclusion of literature was that it was published in Paraguay or specifically deals with Paraguay, or in the case of international publications that it makes specific reference to Paraguayan specimens. The maps included in Neris et al. (2002) were omitted from this compilation. These maps were based on interviews with local people and contain numerous, obvious errors that I am keen not to perpetuate here. Also excluded are the results of Rapid Ecological Evaluations produced and published locally, due to the tendency amongst authors to extrapolate distributions without the necessary evidence in an effort to enhance the results produced after limited field time. On the advice of the author José Luis Cartes records of C. bravissimus in Cartes (2008) were also omitted and considered superseded by the data presented in Cartes et al. (2014). Every effort was made to be thorough with regard to critical inclusion of the literature, though undoubtedly some obscure references will have been missed and some mistakes will have been made.

A statement on the ecological affinities of each species in Paraguay is provided based on the ecoregions defined in del Castillo and Clay (2005) and Mereles (2013). These can be broadly defined as follows: Atlantic Forest (subtropical humid forests of eastern Paraguay), Cerrado (central South American bushy savanna of northern eastern Paraguay), Dry Chaco (low, and thorn forest and scrub of the western Occidental region), Humid Chaco (palm savanna and marshlands of the Paraguay River Basin), Pantanal (gallery forests and swamps of the north-eastern Chaco), Cerrados del Chaco (an area of Cerrado in the northern Chaco contiguous with the Chiquitania of Bolivia), and Mesopotamian Grasslands (flooded grasslands of the southern Oriental region).

Species accounts

Pampas fox

*Lycalopex gymnocerus* (Fischer, 1814)

*Procyon gymnocrurus* (Fischer 1814). Based solely on “1’Agourachay” of de Azara (1801), therefore, type locality was Paraguay. Restricted by Cabrera (1958) to “vicinity of Asunción”, though this lies outside the known range of the species (Smith and Ríos in press).

*Dusicyon gymnocrurus* (Wetzel and Lovett 1974 [specimens], Seese et al. 1981 [parasitology]).

*Dusicyon gymnocrurus* (Schmidt and Martin 1978 [parasitology], Brooks 1992 [ecology], Villalba and Yanosky 2000 [ecology, tracks], Klassen 2007 [guide]).


*Dusicyon gymnocrurus* (Lowen et al. 1996 [distribution], Hill and Padwe 2000 [mention]).

*Pseudalopex* (Neris and Colman 2001 [folklore, use]).

*Pseudalopex (Dusicyon) gymnocrurus* (Fariña and Hostettler 2003 [list]).

*Lycalopex gymnocrurus* (Gamarra de Fox et al. 1998 [conservation], Ramírez Pinto and Velázquez 2010 [checklist], Rumbo 2010 [biogeography], González et al. 2019 [distribution], Weiler et al. 2019 [guide], Smith and Ríos in press [nomenclature, taxonomy]).

Local names

Aguaça chi’i (Villalba and Yanosky 2000); Aguará-pyáta (Wetzel and Lovett 1974).

ACHÉ: Mberembó (Villalba and Yanosky 2000); Pepe jyká (Villalba and Yanosky 2000).

ÁVA: Guarachai (Villalba and Yanosky 2000).

AYOREO TOTOBIEGOSODE: Eapojagué (Sánchez et al. 2020).

PÁI TAVYTÀRA: Guarachai (Villalba and Yanosky 2000).

SPANISH: Zorro de pampa (Areskoug 2001); Zorro de monte (Neris and Franco Rivarola 2005); Zorro Azara (Klassen 2007); Zorro gris (Klassen 2007). The indigenous name Aguaça-pyáta translates as “red fox”, whilst the Spanish name Zorro de pampa translates to “pampas fox”.

Comments

There has been considerable disagreement over the correct generic name for South American “grey foxes” (Thomas 1914, Cabrera 1931, Osgood 1934, Langguth 1975, Clutton-Brock et al. 1976, van Gelder 1978, Berta 1987, 1988, Tedford et al. 1995). The genera *Pseudalopex* (Burmeister 1854) and *Dusicyon* (Hamilton-Smith 1839) have both been employed in the recent past, but according to the genetic results of Tchaicka et al. (2016) *Lycalopex* (Burmeister 1854) correctly applies to the genus as currently understood, with *Pseudalopex* applicable only if the basal species *L. vetulus* is excluded.

The taxonomic history of the group has long been the subject of debate and species limits are far from resolved (Zunino et al. 1995, Prevosti et al. 2013, Tchaicka et al. 2016, Chemisuyq et al. 2019). Cranial morphometrics have suggested that this species is indistinguishable from the Patagonian grey fox *L. griseus* (Zunino et al. 1995, Prevosti et al. 2013) and, indeed, some specimens from within the proposed range of this species show mtDNA sequences identical to *L. griseus*, despite the two species apparently not even being sisters (Tchaika et al. 2016). To further complicate matters, the subspecific identity of the small, dark, short-haired Chaco population is undetermined, while those of the large, pale, long-haired “eastern” population (to date known only from Isla Yacyretá) have been referred to the nominate (Lucheri and Vidal 2008) and these may in fact represent distinct species (Chemisuyq et al. 2019).

Geographical distribution

Largely confined to the Chaco region, where it is widely sympatric with *C. thous*. Though the two overlap throughout the region, this species is most numerous in more xeric habitats, whilst *C. thous* is the dominant species in more humid habitats. Consequently, this species seems to increase in abundance from east to west, whilst the opposite is true of *C. thous*, and the two are of approximate equal abundance in the central Chaco ecoregion. This species is thus most common in the Dry Chaco and Cerrados del Chaco ecoregions, and less common in the Humid Chaco and Pantanal ecoregions where it is largely rare or absent from marshy areas.

Presence in the Oriental region of Paraguay has long been a subject of discussion, and the appearance of this species in faunal lists and popular literature across that region (e.g. in EERs, Gamarra de Fox and Martin 1996, Lowen et al. 1996, Hill and Padwe 2000, Esquivel 2001, Neris and Colman 2001, Neris et al. 2002, Fariña and Hostettler 2003, Rumbo 2010, Weiler et al. 2019) refer invariably to undocumented sight records and seem to be an artifact of duplicated misidentification, assumption, and/or repeated error. Indeed, the presence of the species in the Mbaracayú Reserve, Canindeyú department has been repeatedly claimed (Lowen et al. 1996, Hill and Padwe 2000, Esquivel 2001, Neris et al. 2002, Fariña and Hostettler 2003), despite the doubt expressed (Zuercher et al. 2001) and molecular testing of canine faeces identified in the field from this locality all proving to be *C. thous* (Zuercher et al. 2003). Yahkke et al. (1998) listed this species for Cerro Corá National Park, Amambay department, but omit it from Defensores del Chaco National Park, Alto Paraguay department. I am unaware of any physical evidence that the species occurs in Amambay. This may be a transcription error, or it may be on the basis of the misidentified specimen MNHN J 774 from “2.5 km N of administration, Cero Corá National Park” (Leg. Jody Stallings 7 February 1981) which is actually *C. thous* (Gamarra de Fox and Martin 1996; specimen examined). I elect to not map it, pending verifiable data. Lowen et al. (1996) report this species from Estancia Sombrero, Cordillera department, but they do not report *C. thous* and there is no documentation of the report. I again consider it doubtful pending verifiable proof and omit it from the distribution of the species. See the exploration of the synonymy in the Paraguayan literature by Smith and Ríos (in press) for further information.

The species is present in low numbers in natural grasslands on Isla Yacyretá, Itapúa department but Smith and Ríos (in press) were unable to find a single verifiable record from anywhere else in the Orient and thus I treat these reports as potentially erroneous pending confirmation. Whilst its presence in the Mesopotamian grasslands ecoregion of southern Paraguay would seem possible, potential occurrence in the Cerrado or Atlantic Forest of the extreme northeast of the Oriental region of Paraguay is also possible based on the known distribution in neighbouring Brazil (Brocardo et al. 2020). However, there is currently no evidence to support its existence on the mainland of Oriental Paraguay. The species is of Least Concern in Paraguay (Saldívar et al. 2017).
Examined specimens

Specimen lacking locality (MJUF), BOQUERÓN: 0.5 km S of admin PN Teniente Enciso (MNHNFPY 775); 2 km N of admin PN Teniente Enciso (MNHNFPY 773); Estancia San Ramón, 48 km SW of Colonia Neuand (MNHNFPY 1045); Picada Saracura, PN Teniente Enciso (MNHNFPY 1041).

Specimens not examined

“Gran Chaco” (CONN 17052); “Paraguay” (CONN 20407, MVZ 145333).

ALTO PARAGUAY: 20 km E of Agua Dulce (CONN 19299); 139 km W of Puerto Sastre (CONN 19308); 144 km NE of Filadelfia (CONN 19302); Agua Dulce (CONN 19300); PN Defensores del Chaco, 10.5 km SW (MSB 54081); Fortín Madrejón (CONN 19312).

BOQUERÓN: 3 km S of Garrapatal’i; 7 km SW of km620 Ruta Transchaco (CONN 17546, 17547); 8 km W of Teniente Ochoa (CONN 17003); 11 km NW Fortín Teniente Pratt Gill (CONN 19301); 32 km W road Mariscal Estigarribia to Teniente Montaña (CONN 16873); 40 km W of Mariscal Estigarribia (CONN 17001); 42 km W road Mariscal Estigarribia to Teniente Montaña (CONN 16865); 49.6 km N by road from Filadelfia (UMMZ 124458); 144 km NE of Filadelfia (CONN 19305, 19306); 900 m NNE of Teniente Ochoa, km557 Ruta Transchaco (CONN 15973); Copagro, km589 Ruta Transchaco (CONN 18528, 18529, 18535, 18536, 18817, 18956, 18961, 19080, 19360, 19361, 19362, 20309, 20410); Estancia Iparoma, 19 km N Filadelfia (CONN 19347, 19348, 19349, 19350, 19351, 19352, 19355, 19356, 19359); Estancia Mbatureta, 90 km W of Mariscal Estigarribia (CONN 19318); Garrapatal’i, 7 km SW of km620 Ruta Transchaco (CONN 18085); km545 Ruta Transchaco (CONN 16225, 16226); km600 Ruta Transchaco (CONN 18527); km607 Ruta Transchaco (CONN 17534); km618 Ruta Transchaco (CONN 17545); km652 Ruta Transchaco (CONN 18013); Loma Plata (KU 142757); Orloff (FMNH 63861); PN Teniente Enciso, km1799 Ruta Transchaco (CONN 17534); km554 Ruta Transchaco (CONN 18185); PN Teniente Enciso km655 Ruta Transchaco (CONN 18082, 18096, 18097); PN Teniente Enciso, field behind buildings km654.5 Ruta Transchaco (CONN 17548, 17551, 17552, 17553, 17554, 18080); Teniente Ochoa (CONN 16224, 16549, Brooks 1992); Sargento Rodríguez, km764 Ruta Transchaco (CONN 17538, 17541, 17543, 17978, 17984, 18083); Sargento Rodríguez, 1 km W (CONN 18017).

GUAYRA: Villarrica (AMNH 95204, 95205), in error?

PRESIDENTE HAYES: 8 km NE of km275 Ruta Transchaco (CONN 17010); 275 km NW by road of Villa Hayes (MVZ 145335); 290 km NW by road of Villa Hayes (MVZ 145334); between Estancia Juan de Zalazár and Teniente Ochoa (CONN 16750); Estancia Juan de Zalazár (CONN 20406); Estancia Juan de Zalazár, 1.5 km W of line camp (CONN 16670); Estancia Juan de Zalazár, 2 km SE of line camp (CONN 16756); Estancia Juan de Zalazár, 11 km W of Transchaco Bridge (CONN 16223); Estancia Juan de Zalazár, near line camp (CONN 16771); Estancia Laguna Pora, Colonia Fernheim, 85 km E of Loma Plata (CONN 19317, 19328, 19337, 19340, 19343, 19345); 15 km 100 Ruta Transchaco (CONN 16751); km113 Ruta Transchaco (CONN 18089); km361 Ruta Transchaco (CONN 17799); Retiro km305 Ruta Transchaco (CONN 17009, 17391); Río Verde, 137 m E of Ruta Transchaco (CONN 16241).

Literature references

ALTO PARAGUAY: Estación Los Tres Gigantes (González et al. 2019).

BOQUERÓN: between Filadelfia junction and Mariscal Estigarribia on Ruta Transchaco (Cartes and Morales 2010); Fortín Toledo (Brooks 1992); Gran Siete (Areskoug 2001); Parque Nacional Teniente Enciso (Yahnke et al. 1998).

BOQUERÓN / PRESIDENTE HAYES: between km174 and Filadelfia junction on Ruta Transchaco (Cartes and Morales 2010).

PRESIDENTE HAYES: between km71 and km173 on Ruta Transchaco (Cartes and Morales 2010); Estancia Amalia (Brooks 1992); Laguna Ganzo (Cartes 2008); Tinfunqué “National Park” (Cartes et al. 2004); Reserva Natural Privada Golondrina (Lowen et al. 1996).

Photographic records

ITAPÚÁ: Isla Yacyretá (Paul Smith).

Reliable observations

BOQUERÓN: Parque Nacional Médanos del Chaco (Paul Smith).

Crab-eating fox

Cerdocyon thous (Linnaeus, 1766)

Canis thous (Linnaeus 1766). Type locality “Surinam”.

Canis azarae s. brasiliensis (Rengger 1930 [ecology, use]).

Canis azarae (Hunter 1838 [translation of Azara]).

Canis thous (Bertoni 1914 [checklist, distribution], Bertoni 1925 [aberration]).

Canis thous (Bertoni 1914 [checklist, hypothetical]).

Cerdocyon thous enterianus forma melampus (Berton 1939 [checklist, distribution]).

Pseudalopex g. gymnicerca (Bertoni 1939 [checklist, distribution]).


Cerdocyon (Dasyicyn) thous (Zuercher et al. 2003 [distribution, identification]).

Cerdocyon thous (Smith et al. 2005a [mention], Smith et al. 2005b [mention]).

Local names

aguaria’i (Villalba and Yanosky 2000); Aguachal (Bertoni 1914); Aguachay (Rengger 1830).

Ava: Peka (Villalba and Yanosky 2000).

ACE: Krachoa (Villalba and Yanosky 2000); Krachoua (Esquivel 2001); Krachova (Farina and Hostetler 2003).

AYOREO TOTOBIEGOSODE: Eapoajagü (Sánchez et al. 2020).

SPANISH: Zorro (Nisir and Franco Rivarola 2005); Zorro cangrejero (Areskoug 2001); Zorro de monte (Areskoug 2001).

Figure 3: Distribution of Lycalops gymnocercus in Paraguay.
The indigenous Guarani name Aguaray’s means “little fox”, whilst the Spanish names translate as Zorro de monte, “forest fox”, and Zorro cangrejero, “crab-eating fox”. de Azara (1801, 1802) stated that the addition of “...chay” to Aguaray had no real meaning, but was added in order to distinguish the fox from C. brachyurus (the maned wolf).

They likely extend their range to the proposed range of C. t. brachyurus.

The indigenous Guaraní name Aguaray’i means “little fox” and Zorro de monte refers to this species alone, and that he clearly believed his Aguarachay to be the same as Azara’s. Nomenclatural confusion reflected in the various synonyms used in the works of Bertoni (1914, 1925, 1939) was clarified by Smith and Rios (in press).

This is a common and widespread fox occurring across the country, where unaltered eucalyptus stands provide seasonal standing water. In rural areas they commonly approach human dwellings.

Specimen lacking locality (MJUF).

 tres areas of the western Dry Chaco is perhaps sporadic and probably partly dependent on climatic conditions, as the species appears to prefer areas where standing water is freely available. They likely extend the range into xeric areas along water courses during wet years, retracting again in drier years.

Examined specimens

Specimen lacking locality (MJUF).

ALTO PARAGUAY: 2.5 km E of Aguas Dulce on Linea 1 (MNHNPY 776); 8 km E of Aguas Dulce on Linea 1 (MNHNPY 779); 10 km E of Aguas Dulce on Linea 1 (MNHNPY 777); 17 km W of Colonia Neuland (MNHNPY 1049, 1050); Aguas Dulce (MNHNPY 802, 803); Gabino Mendoza (MNHNPY 2217); PN Defensores del Chaco (MNHNPY 3259).

BOQUERÓN: Estancia Campo María (MTD 11465); Carapeguá Mt Bogarín (AMNH 234219). The correct name for the taxon in Paraguay was the subject of much debate. The indigenous Guaraní name Aguaray was first used in disambiguation of the species in Paraguay, Rengger (1830) noted that it was formerly regularly domesticated and that, when accompanying a hunt, the species showed greater tracking aptitude than trained hunting dogs, but that it tired more rapidly.

Examined specimens

Specimen lacking locality (MJUF).

ALTO PARAGUAY: 36.1 km W by road of Fortín Madrejón (UMMZ 124459); 48 km NW of Fortín Madrejón (CONN 19311); 50 km NW of Madrejón, Misión Nuevo Tribu (UMMZ 124460, 125566, 125567); 78 km N of Fortín Madrejón (CONN 19298); 139 km W of Puerto Sastre (CONN 19144) (c.44 km NE of Filadelfia (CONN 19303, 19304); Estancia Laguna General Díaz (MHNG 1706.013); Fortín Madrejón (UMMZ 124461); Pablo La Gerena, 29 km N of Fortín Madrejón (AMNH 248466); surroundings of 20°46-57S, 59°48-53W, c.15-33 km S of Fortín Madrejón (MTD-B 24883; Ziegler et al. 2002).

BOQUERÓN: 22°35S, 59°40W (CONN 16548); La Gerenza, 29 km SW of Filadelfia (CONN 15765, 15767, 15768, 16243, 16443, 16483); Estancia San Ramón, 2 km SW from Rio Verde station (CONN 15972); Estancia Juan de Zalazar, 4 km SW line camp (CONN 17390); Estancia Juan de Zalazar, 500 m N line camp (CONN 16773); Estancia Juan de Zalazar, 500 m W Transchaco bridge (CONN 16239); Estancia Juan de Zalazar, between Transchaco bridge and Rio Verde station (CONN 16550); Estancia Juan de Zalazar, left bank of Rio Verde near Transchaco bridge (CONN 16240); Estancia Laguna Pora, Colonia Fernheim, 85 km E of Loma Plata (CONN 19313, 19314, 19315, 19316, 19319, 19210, 19321, 19322, 19323, 19324, 19325, 19326, 19327, 19329, 19330, 19331, 19332, 19333, 19334, 19335, 19336, 19339, 19341, 19342, 19344, 19346); km55.5 Ruta Transchaco (CONN 17376); km57 Ruta Transchaco (CONN 17531); km250 Ruta Transchaco (CONN 17532); 15 km SW of km589 Ruta Transchaco (CONN 20403); 39.5 km W road Mariscal Estigarribia to Terrenas Montana (CONN 16871); Copagro, km59 Ruta Transchaco (CONN 18536, 18552, 18553, 18567); Filadelfia Experimental Station, 295 km NW by road of Villa Hayes (MVZ 153331, 153332, 153336); Estancia Apacende km293 Ruta Transchaco (MHNG 1689.065); Estancia Iparoma, 0.5 km SW (CONN 19338); Estancia Iparoma, 19 km N of Filadelfia (CONN 19353, 19354, 19357, 19363); Estancia Juan de Zalazar (CONN 15765, 15767, 15768, 16243, 16443, 16483); Estancia Juan de Zalazar, 1 km NW of Transchaco bridge (CONN 19358); Estancia Juan de Zalazar, 1 km W of Transchaco bridge (CONN 19359); Estancia Juan de Zalazar, 2 km W of Transchaco bridge (CONN 19360); Estancia Iparoma, 0.5 km SW (CONN 19338); Estancia Iparoma, 19 km N of Filadelfia (CONN 19353, 19354, 19357, 19363); Estancia Juan de Zalazar (CONN 15765, 15767, 15768, 16243, 16443, 16483); Estancia Juan de Zalazar, 1 km NW of Transchaco bridge (CONN 19359).
Maned wolf

Chrysocyon brachyurus (Illiger, 1815)

Canis brachyurus (Illiger 1815). Name based on “Aguara-Gouazou” of de Azara (1801). Type locality not given, but restricted to “los esteros del Paraguay” (Cabrera 1958).

Canis jubatus (Rengger 1830 [ecology], Hunter 1838 [translation of Azara], Bertoni 1914 [checklist, distribution]).


Local names

Aguard (Bertoni 1914); Zorro de crin (Areskoug 2001); Aguara guasu (Neris and Franco Rivarola 2005); Aguara pitá (Battilana 1995); Yagua pyta (Rengger 1830). Aguará guasú (Rengger 1830); Aguara guasu (Neris and Franco Rivarola 2005); Aguara pitá (Battilana 1995); Yagua pyta (Rengger 1830).

SPANISH: Lobo de crin (Esquivel 2001); Zorro de crin (Areskoug 2001).

Comments

The indigenous name Aguara-guasú means “big fox”, whilst the Spanish name Zorro o Lobo de crin translates to “manned fox or wolf”. Rengger (1830) suggested that the name Aguara was derived from the A-gua-a of the species. The priority of C. brachyurus over C. jubatus (Desmarest 1820), in use at the turn of the 20th Century, was demonstrated by Osgood (1919). The species is monotypic (Dietz 1985).

The first report referring unequivocally to this species was by de Azara (1801; history of canid studies section) who made notable claims about the ecology of the species, including an intolerance of raw beef and the presence of parasitic worms in the kidneys. Rengger (1830) confirmed the former observations, recounting the experience of Dr Parlet who had kept a domestic individual for over a year. Both authors provided natural history data that has not been improved upon by any Paraguayan-based researcher to date.

There are no studies of the ecology of this species specific to Paraguay that have yet been published, and just two modern publications (last 50 years) dealing specifically with the species in Paraguay: Cartes et al. (2014) provided a brief summary of what is known about this species and how it applies to Paraguay; Meritt (1973) a short note on its inclusion in the wildlife trade. A recent conservation assessment concluded that the species is Vulnerable in Paraguay (Giordano et al. 2017).

Geographical distribution

Fairly widespread at low density in grassland and forest edge habitats across the Oriental region of Paraguay and more humid areas of the Paraguayan Chaco (including the Cerrado, Atlantic Forest, Mesopotamian Grassland, Pantanal, Cerrados del Chaco and Humid Chaco ecoregions, with marginal occurrence in the Dry Chaco. The species prosper where un molested, and is able to tolerate habitat destruction where patches of natural habitat and sufficient food resources persist. They are even present in agricultural areas in the southern Oriental region, especially rice fields. A general regional distribution of the species was provided by Queirolo et al. (2011).
Specimens not examined

“Paraguay” (AMNH 61144; FMNH 46003, 54406; MIZ 28628, 28629, 28630; NMR 999999001004).

CAAGUAÚ: Junction of the Iguaçu and Yaquei Rivers (MCZ 28615); Río Yaqueí (MCZ 30267).

PRESIDENTE HAYES: 15 km SW Fortín Gloria Meyer (CONN 19309); Estancia Juan de Zalazar (CONN 17989, Cartes et al. 2014); Estancia Juan de Zalazar, 2 km W of Transchaco bridge (CONN 17394).

Literature references

ALTO PARAGUAY: Estación Los Tres Gigantes (Cartes et al. 2014; González et al. 2019); Río Negro National Park (Cartes et al. 2004).

ALTO PARANÁ: Itapí Dam “zone of influence” (von Humbeck and Silveira Aválos 1995, Cartes et al. 2014); Mondah (Bertoni 1914).

AMAMBAY: Cerro Corá National Park (Cartes et al. 2014); Reserva Natural Kai Rague (Cartes et al. 2014).

BOQUERÓN: Gran Siete (Aresköog 2001).


CENTRAL / PARAGUARÍ: Lago Ypóa (Cartes et al. 2004).

CONCEPCIÓN: Arroyo Tagatía Mi (Cartes et al. 2014); Estancia Estrella (Cartes et al. 2014); Paco Bravo National Park (Cartes et al. 2014); Serranía San Luis National Park (Cartes et al. 2014).

CORDILLERA: Arroyos y Esteros, Ruta III km79 (Cartes et al. 2014); Reserva Natural Sombrero (Cartes et al. 2014).

MISIONES: Estancia La Graciela (Cartes et al. 2014).

NEÉMBOCÚ: Estancia Redondo (Cartes et al. 2014).

PRESIDENTE HAYES: Estancia El Trébol, entrance (Cartes et al. 2014); Estancia El Trébol at km23 of Ruta XII (Cartes et al. 2014); Estancia Golondrina (Cartes et al. 2014); Estancia Karanda (Cartes et al. 2014); Estancia La Petrona (Cartes et al. 2014); Estancia Maroma (Cartes et al. 2014); Estancia Pozo Azul (Cartes et al. 2014); Estancia Santa Asunción (Cartes et al. 2014); Estancia Santa María del Doce (La Piedad, Cartes et al. 2014); km40 Ruta N (Cartes et al. 2014); km60 Ruta Transchaco (Cartes et al. 2014); km70 Ruta Transchaco, close to Estancia Buena Vista (Cartes et al. 2014); km175 Ruta Transchaco (Cartes et al. 2014); km240 Ruta Transchaco, Estancia La Victoria (Cartes et al. 2014); km250 Ruta Transchaco, close to Pirahú (Cartes et al. 2014); km286.7 Ruta Transchaco (Cartes et al. 2014); Reserva Torro Mocho (Cartes et al. 2014); Tinifunquí “National Park” (Cartes et al. 2004; Cartes et al. 2014).

SAN PEDRO: Estancia Don Luís (Cartes et al. 2014); Rancho Laguna Blanca (Smith et al. 2005b, Cartes et al. 2014); Estancia Señorita (Cartes et al. 2014).

Photographic records

SAN PEDRO: Agroforestal Río Verde (Para La Tierra).

Reliable observations

CANINDEYÚ: Aguara Nú, Reserva Bosque Mbaracayú (Paul Smith).

ITAPÚA: Cauce San Cosné, Ruta I (Paul Smith).

Bush dog

Speothos venaticus (Lund, 1842)

Type locality “Lagoo Santa, Minas Gerais, Brazil”.


Leticyon venaticus (Masi Pallarés 2011 [guide]).

Local names

Jagua pytáng (Villalba and Yanosky 2000); Jagua yyyuy (Villalba and Yanosky 2000).

ACHE: Betapá (Fariña and Hostettler 2003); Mbétpá (Villalba and Yanosky 2000).

AYA: Jagua turutù e (Villalba and Yanosky 2000).

MBYA: Jagua saite (Villalba and Yanosky 2000); Jagua turutù e (Villalba and Yanosky 2000).

PAI TAVITÉRA: Jagua rova pe (Villalba and Yanosky 2000); Táí wava (Villalba and Yanosky 2000).

SPANISH: Perro de agua (Esquivel 2001); Zorro vinagre (Esquivel 2001).

Comments

Translations of some of the indigenous names are as follows: Jagua pytáng “pink dog”; Jagua yyyuy “burrowing dog”. The Spanish names translate as Perro de agua, “water dog”, and Zorro vinagre, “vinegar fox”. There are three subspecies, with Paraguay within the range of the nominate subspecies (de Mello Beissiegel and Zuercher 2005).

Bertoni (1939) included this species in his broad concept of the Mustelidae (which also included Mephitidae). Members of the Aché, Mbyá, and Avá indigenous groups at least previously captured the species for food, and individuals were kept as hunting dogs for hunting pacas Agouti pacas and armadillos (Dasypodidae, Chlamyphoridae; Zuercher and Villalba 2002).

First reported for Paraguay by Bertoni (1924) who reported on a specimen captured by Sr. Fortunato Amarilla on the Río Apa in the foothills of the Cordillera del Amambay in 1921. The author also mentioned having never encountered the species in Alto Paraná in thirty years. von Humbeck and Pérez (1998) stated that “the species is known from the Concepción area in the Río Apa region”, but it seems that this may have been based on the abbreviated distribution of “Río Apá” given in Bertoni (1939), when in fact Bertoni (1924) makes it clear that the true locality was in Amambay department. Zuercher and Villalba (2002) provided physical evidence of the species at two localities in the Oriental region, and noted that local people at Reserva Natural Privada Ypetí (=Estancia Golondrina I, CAN/CAAA) and Mbéhp hunters at San Rafael National Park (CAZITRA) reported the presence of the species. These localities, plus others not included in Zuercher and Villalba (2002), were then listed as protected areas in which the species occurs in Paraguay in Zuercher et al. (2004), but it is unclear whether or not additional information became available in the interim. Beccaceci (1994) includes some information about the species provided to the author by the Ache of the Reserva Bosque Mbaracayú (CAN) and Saldívar Bellasal et al. (2020) the first camera trap photograph of the species from the Reserva Natural Carapá (CAN).

The live specimen in the zoo at the Botanic Garden in 1923 came from the “Paraguayan Chaco” according to C. Fiebig (Bertoni 1924). Claimed presence in “Bahía Negra” and Alto Paraguay department may have its basis in

Figure 5: Distribution of Chrysocyon brachyurus in Paraguay.
this report (von Humbeck and Pérez 1998, Neris et al. 2002, Cartes et al. 2004, Cartes 2008, Giordano et al. 2017), but I am not aware of any confirmation of existence in this area of the country. Indeed, the historical distribution illustrated by Neris et al. (2002) based on interviews with local people, includes almost the entire Oriental region, a good portion of the Humid Chaco and a wide distribution in Alto Paraguay department, but this perhaps owes more to the imagination of the respondents than to the presence of the species. I suggest that, given the rarity of this species, a more conservative approach to the reporting of its distribution will be of greater utility for effective management.

Details of the breeding programme for this species at the Centro de Investigación de Animales Silvestres de Itaipú (CIASI) were published in von Humbeck and Pérez (1998). The series of CBMI specimens with vague localities such as “Hernandarias, Alto Paraná” and “Refugio Fauna, Alto Pararan” presumably originated from captive specimens within this programme. A recent conservation assessment concluded that the species is Endangered in Paraguay (Giordano et al. 2017).

Geographical distribution

Very poorly known, indeed many of the localities proposed for the species in Paraguay are based on hearsay and local reports, and adequate documentation of distribution is thin on the ground. The species appears to historically have been restricted to a relatively small area of the eastern Atlantic Forest region with sandy and clay soils, west as far as 56º W (von Humbeck and Pérez 1998).

Examined specimens

None.

Specimens not examined

CBMI 0020, 0036, 0043, 0126, 0129, 0143, 0147, 0156, 0199, 0253, 0264.

CANINDEYÚ: Curuguaty (CBMI 0120).

Literature references

“Chaco” (Bertoni 1924, 1939).


AMAMBAY: Río Apá at the foot of the Cordillera del Amambay (Bertoni 1924, 1939); Reserva Natural Privada Ka’i Rague (Zuercher et al. 2004).

CAAGUAZÚ: Parque Nacional San Rafael (Zuercher et al. 2004); Serranía de San Joaquín near the mouth of the Río Acaray (von Humbeck and Pérez 1998); Tacuarázú settlement on the Ypetí River (Zuercher and Villalba 2002); Ypetí (Brooks et al. 1993, Zuercher et al. 2004, Cartes 2008).

CAAGUAZÚ/ CANINDEYÚ: Reserva Natural Privada Morombí (=Reserva Privada Golondrina II, Zuercher et al. 2004).


Photographic records

None.

Reliable observations

CANINDEYÚ: Reserva Natural Itábio (Hugo del Castillo).

Discussion

Four species of Canidae in four genera are reaffirmed to occur in Paraguay. The family is fairly well-represented in the specimen record, though there is a taxonomic bias towards two species (C. thous and L. gymnocrus) and a strong geographical bias towards collection in the Chaco region.

A chronic lack of study of this family means that local knowledge has advanced little since the publications of de Azara (1801) and Rengger (1830) in the early 19th Century, and much of what we claim to know about these species is extrapolated from field work carried out in neighbouring countries. Population estimates are not available for either of the globally and nationally threatened species (C. brachyurus and S. venaticus) that occur in Paraguay (Giordano et al. 2017), and presence and absence data is based almost entirely on chance encounters by a limited number of reporters. Indeed, the distribution of the rarely-recorded S. venaticus is almost exclusively based on inference and local knowledge, and the current distribution may in fact be greatly over-estimated as a result. Such a lack of basic data for these two species is undoubtedly seriously hampering our attempts to conserve them.

Acknowledgements

I. Gamarra de Fox (Museo Nacional de Historia Natural del Paraguay) and G. Hicks (Colección Zoológica Para La Tierra) provided assistance in the revision of specimens. Julio R. Contreras donated essential literature that was used in this work. The author was assisted by, and is grateful to, the Proni program of CONACyT Paraguay. We thank the anonymous librarian behind the Biodiversity Heritage Library project for making scarce works available that were key to this project. I am grateful to S. Ríos (Ministerio de Cultura) for commenting on earlier drafts of this work, and H. del Castillo (Guaya Paraguay) for sharing his observation. B. Garcez produced the map for Figure 2.

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**Biographical sketch**

Paul Smith is a British zoologist and eco-tour guide based in Paraguay since 2004. A level 2 scientist in the Pronui program of CONACyT, he is the founder of FAUNA Paraguay ([www.faunaparaguay.com](http://www.faunaparaguay.com)), president of Par La Tierra ([www.parlaterra.org](http://www.parlaterra.org)) and has published over 150 peer-reviewed papers and books on Paraguayan fauna.
Appendix 1. Collection codes for museums housing Paraguayan Canid specimens

AMNH American Museum of Natural History, New York, USA
CBMI Colección Biológica Museo de Itaipú, Hernandarias, Paraguay.
CONN University of Connecticut Museum of Natural History, Storrs, USA
CZPLT Colección Zoológica Para La Tierra, Pilar, Paraguay.
FMNH Field Museum of Natural History, Chicago, USA.
KU Kansas University Natural History Museum, Lawrence, USA.
MJUF Museo Jakob Unger, Filadelfia, Paraguay
MCZ Museum of Comparative Zoology, Harvard University, Cambridge, USA.
MHNG Musée d’histoire naturelle de Geneve, Switzerland.
MNHNPy Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay
MSB University of Mexico Museum of Southwestern Biology, Albuquerque, USA
MTD Museum für Tierkunde, Dresden, Germany
MVZ Museum of Vertebrate Zoology, Berkeley, USA.
NMR Natural History Museum, Rotterdam, Netherlands
NRM Naturhistoriska Riksmuseet (Swedish Museum of Natural History), Stockholm
RBINS Royal Belgian Institute of Natural Sciences, Brussels, Belgium
UMMZ University of Michigan Museum of Zoology, Ann Arbor, USA
USNM Smithsonian National Museum of Natural History, Washington D.C., USA
TTU Texas Tech University Museum, Lubbock, Texas, USA.